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LABORATORY TESTS OF TOXICITY OF SOME ORGANIC COMPOUNDS TO THE EUROPEAN CORN BORER, 1947 to 1952

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The results of laboratory tests with some organic compounds against newly hatched larvae of the European corn borer (*Pyrausta nubilalis* (Hbn.)) at Toledo, Ohio, and Ankeny, Iowa, are herein reported. These tests were conducted by the Division of Cereal and Forage Insect Investigations from 1947 through 1950. Similar tests with other compounds have been reported in E-557, E-612, E-620, E-707, E-748, E-778, and E-781 of this Bureau. All were supplied by the Division of Insecticide Investigations.

The care and handling of moths, eggs, and larvae and the technique employed in conducting these tests are described in E-557. In the initial tests either 2 or 4 pounds of the compound was used per 100 gallons of water containing 1/3 pound of a sodium monosulfonate of butylphenylphenol as a wetting agent. All compounds had been ground with an equal weight of clay. Most of them were sprayed at the 4-pound concentration on fresh green corn leaves. The few compounds first tested at 2 pounds were sprayed on fresh cauliflower leaves. For each test approximately the same number of larvae were used in the treated and untreated checks. All larvae were given an opportunity to feed for 48 hours before mortality readings were taken. Materials showing a mortality of 10 percent or higher in the initial tests were retested at lower concentrations. Results of these tests are given in table 1. Results with materials showing less than 10 percent mortality are given in table 2. The mortality in the checks was never higher than 2 percent.

Table 1.--Results against the European corn borer of toxicity tests with organic compounds that showed a mortality of 10 percent or more in initial tests and were retested at lower concentrations given in order of effectiveness

Compound	Concentration per 100 gallons	Borers used	Feeding	Average mortality
	Pounds	Number		Percent
Benzoic acid, cinnamylidene-	4	65	None	100
hydrazide	2	65	None to little	99
$C_6H_5CONHN:CHCH:CHC_6H_5$	1	146	do.	67
	1/2	71	Moderate	24
	1/4	62	do.	11
Methane, tetrakis-	4	125	None	100
(chloromethyl)-	2	289	do.	83
$C(CH_2Cl)_4$	1	305	Much	12
	1/2	332	do.	2
Ether, 2,4-dinitrophenyl phenyl	4	87	None	100
$C_6H_3(NO_2)_2OC_6H_5$	2	92	Moderate	62
	1	46	do.	42
Ether, 2,4-dinitrophenyl phenethyl	4	45	None	100
$C_6H_3(NO_2)_2OCH_2CH_2C_6H_5$	2	42	Moderate	46
	1	24	Much	0
Benzoic acid, o-(2,4-	4	121	None to little	98
dinitrophenoxy)-	2	75	Moderate	69
$(NO_2)_2C_6H_3OC_6H_4COOH$	1	94	Much	25
	1/2	89	do.	4
Benzoic acid, p-nitro-	4	85	None	99
cinnamylidenehydrazide	2	117	None to much	37
$NO_2C_6H_4CONHN:CHCH:CHC_6H_5$	1	71	Moderate to much	18
Ether, 2-cyclohexyl-4,6-	4	106	None	95
dinitrophenyl 2,4-dinitrophenyl	2	54	Moderate	85
$C_6H_3(NO_2)_2OC_6H_2(C_6H_{11})(NO_2)_2$	1	48	Much	69
2-Cyclohexene-1-one,	4	174	Little	95
2,3,4,4,5,6,6-heptachloro	2	99	Moderate	8
$\underbrace{CCl:CClCCl_2CHClCCl_2CO}$	1	77	Much	3

Table 1. --(Continued)

Compound	Concentration per 100 gallons	Borers used	Feeding	Average mortality
	Pounds	Number		Percent
Ether, 2,4-dinitrophenyl	4	108	None	92
4-methylcyclohexyl	2	107	Moderate	78
$C_6H_3(NO_2)_2OC_6H_{10}CH_3$	1	88	Much	45
	1/2	83	do.	10
Ether, benzyl 2,4-dinitrophenyl	4	37	None to little	84
$C_6H_3(NO_2)_2OCH_2C_6H_5$	2	47	Little to moderate	64
	1	26	Much	19
Ethane, 1-(p-tert-butylphenoxy)-	4	96	Much	83
2-(2,4-dinitrophenoxy)-	2	66	do.	33
$(NO_2)_2C_6H_3OC_2H_4OC_6H_4C(CH_3)_3$	1	80	do.	13
Ether, cyclohexyl 2,4-dinitrophenyl	4	37	Little	81
$C_6H_3(NO_2)_2OC_6H_{11}$	2	28	Much	0
Benzoic acid, piperonylidene-	4	65	None to little	77
hydrazide	2	84	Much	52
$C_6H_5CONHN{:}CHC_6H_3{:}O_2CH_2$	1	59	Much	3
Ether, 2,4-dinitrophenyl	4	33	None to moderate	70
tetrahydrofurfuryl	2	40	Moderate to much	41
$C_6H_3(NO_2)_2OCH_2\underbracket{CH(CH_2)_3O}$	1	29	Much	21
Phenetole, 2,4-dinitro-	4	34	Moderate	62
$C_6H_3(NO_2)_2OC_2H_5$	2	21	Much	10
	1	22	do.	9
Benzoic acid, alpha-methyl-	4	69	None to much	50
benzylidenehydrazide	2	135	Much	1
$C_6H_5CONHN{:}C(CH_3)C_6H_5$				
p-Toluhydroquinone	4	75	Moderate	37
$CH_3C_6H_3(OH)_2$	2	97	Much	8

Table 1.--(Continued)

Compound	Concentration per 100 gallons	Borers used	Feeding	Average mortality
	Pounds	Number		Percent
p-Quinone, 2,5-di-tert-butyl-	4	112	Moderate	30
$O{:}C_6H_2[C(CH_3)_3]_2{:}O$	2	100	Much	2
Acetaldehyde, 2-chloroethyl	4	49	Moderate to much	29
2,4,5- trichlorophenyl acetal	2	64	Much	0
$CH_3CH(OCH_2CH_2Cl)OC_6H_2Cl_3$				
Ether, *p*-(alpha, alpha-dimethyl-	4	49	-	18
benzyl)phenyl 2,4-dinitrophenyl	2	39	-	8
$C_6H_3(NO_2)_2OC_6H_4C(CH_3)_2C_6H_5$	1	35	-	0
Ether, *p*-tert-butylphenyl	4	45	-	13
2,4-dinitrophenyl	2	31	-	9
$C_6H_3(NO_2)_2OC_6H_4C(CH_3)_3$	1	24	-	0
Aniline, N-allyl-2,4-dinitro-	4	134	-	10
$(NO_2)_2C_6H_3NHCH_2CH{:}CH_2$	2	91	-	1

Table 2.--Results against the European corn borer of toxicity tests with organic compounds showing less than 10 percent mortality in order of effectiveness

Compound	Concentration per 100 gallons	Borers used	Average mortality
	Pounds	Number	Percent
O-Ethyl O,O-bis(*p*-nitrophenyl) thiophosphate $C_2H_5OP(S)(OC_6H_4NO_2)_2$	4	135	8
Acetic acid, 4,6-dinitro-*o*-toloxy- $(NO_2)_2(CH_3)\ C_6H_2OCH_2COOH$	2	173	6
Benzoic acid, *p*-nitro-,alpha-methylbenzylidene-hydrazide $NO_2C_6H_4CONHN{:}C(CH_3)C_6H_5$	4	178	6
Benzaldehyde, 3-methoxy-4-(2,4-dinitrophenoxy)- $C_6H_3(NO_2)_2OC_6H_3(OCH_3)CHO$	4	105	5
Phenol, 2-chloro-4,6-dinitro- $ClC_6H_2(NO_2)_2(OH)$	2	218	5
Aniline, 2,5-dimethoxy- $NH_2C_6H_3(OCH_3)_2$	4	115	4
Benzene, 1,3-bis(2,4-dinitrophenoxy)- $C_6H_4[OC_6H_3(NO_2)_2]_2$	4	113	4
Benzene, 1,4-bis(2,4-dinitrophenoxy)- $C_6H_4[OC_6H_3(NO_2)_2]_2$	4	93	4
Benzoic acid, *p*-nitro-,*o*-chlorobenzylidene-hydrazide $NO_2C_6H_4CONHN{:}CHC_6H_4Cl$	4	74	4
Benzoic acid, *p*-nitro-2,2,2-trichloroethylidene-hydrazide $NO_2C_6H_4CONHN{:}CHCCl_3$	4	101	4

Table 2.--(Continued)

Compound	Concentration per 100 gallons	Borers used	Average mortality
	Pounds	Number	Percent
Ethanol, 2,2'-(phenylimino)di- $C_6H_5N(C_2H_4OH)_2$	4	117	4
Ether, p-chlorophenyl 2,4-dinitrophenyl $C_6H_3(NO_2)_2OC_6H_4Cl$	4	102	4
Ether, o-cyclohexylphenyl 2,4-dinitrophenyl $C_6H_3(NO_2)_2OC_6H_4C_6H_{11}$	4	43	4
Ether, 2,4-dinitrophenyl o-nitrophenyl $C_6H_3(NO_2)_2OC_6H_4NO_2$	4	84	4
Ether, 2,4-dinitrophenyl o-tolyl $C_6H_3(NO_2)_2OC_6H_4CH_3$	4	73	4
Ether, 2,4-dinitrophenyl 2,4,6-trichlorophenyl $C_6H_3(NO_2)_2OC_6H_2Cl_3$	4	81	4
Acetic acid, 2,4-dinitrophenoxy- $(NO_2)_2C_6H_3OCH_2COOH$	2	231	3
Aniline, 2,5-diethoxy- $NH_2C_6H_3(OC_2H_5)_2$	4	124	3
Ether, 2,4-dichlorophenyl 2,4-dinitrophenyl $C_6H_3(NO_2)_2OC_6H_3Cl_2$	4	71	3
Ether, 2,4-dinitrophenyl 2-nitro-p-tolyl $C_6H_3(NO_2)_2OC_6H_3(NO_2)CH_3$	4	98	3
Phenol, p-methoxy- $HOC_6H_4OCH_3$	4	103	3

Table 2.--(Continued)

Compound	Concentration per 100 gallons	Borers used	Average mortality
	Pounds	Number	Percent
Acetic acid, *o*-cyclohexylphenoxy- $(C_6H_{11})C_6H_4OCH_2COOH$	2	186	2
Anisole, 5-allyl-2-(2,4-dinitrophenoxy)- $(NO_2)_2C_6H_3OC_6H_3(OCH_3)CH_2CH{:}CH_2$	4	117	2
Benzoic acid, *p*-nitrocyclopentylidenehydrazide $NO_2C_6H_4CONHN{:}\underbrace{C(CH_2)_2CH_2}$	4	183	2
Benzoic acid, *p*-nitro-,2-ethylbutylidenehydrazide $NO_2C_6H_4CONHN{:}CHCH(C_2H_5)CH_2CH_3$	4	73	2
Benzoic acid, *p*-nitromethylenehydrazide $NO_2C_6H_4CONHN{:}CH_2$	4	247	2
Ethanol, 2,2'-(*m*-tolylimino)di- $CH_3C_6H_4N(C_2H_4OH)_2$	4	103	2
Ether, *o*-chlorophenyl 2,4-dinitrophenyl $C_6H_3(NO_2)_2OC_6H_4Cl$	4	78	2
Ether, 2,4-dinitrophenyl 2-naphthyl $C_6H_3(NO_2)_2OC_{10}H_7$	4	78	2
p-Nitrophenyl phosphate $(C_6H_4NO_2)_3PO_4$	4	229	2
Phenol, *o*-benzylideneamino- $C_6H_5CH{:}NC_6H_4OH$	4	106	2
p-Quinone, 2,3,5-trichloro-6-phenyl $O{:}C_6(C_6H_5)Cl_3{:}O$	4	121	2

Table 2.--(Continued)

Compound	Concentration per 100 gallons	Borers used	Average mortality
	Pounds	Number	Percent
p-Toluenesulfonic acid, o-cyclohexyl-4,6 dinitrophenyl ester $CH_3C_6H_4SO_3C_6H_2(NO_2)_2(C_6H_{11})$	4	223	2
m-Toluic acid, 2-(2,2-dinitrophenoxy)- $CH_3C_6H_3(COCH)OC_6H_3(NO_2)_2$	4	141	2
p-Toluenesulfonic acid, 2,4-dinitrophenyl ester $CH_3C_6H_4SO_3C_6H_3(NO_2)_2$	2	233	2
Aniline, N-sec-butyl-2,4-dinitro- $(NO_2)_2C_6H_3NHCH(C_2H_5)CH_3$	4	209	1
Benzoic acid, isopropylidenehydrazide $C_6H_5CONHN{:}C(CH_3)_2$	4	72	1
Benzoic acid, p-nitro-, cyclohexylidenehydrazide $NO_2C_6H_4CONHN{:}\underline{C(CH_2)_4CH_2}$	4	167	1
Ether, 2-biphenylyl 2,4-dinitrophenyl $C_6H_5C_6H_4OC_6H_3(NO_2)_2$	4	127	1
Hydroquinone, 2,5-di-tert-butyl- $C_6H_2(OH)_2[C(CH_3)_3]_2$	4	87	1
Phenol, p-butylamino- $HOC_6H_4NHC_4H_9$	4	147	1
Phenol, o-(p-chlorobenzylideneamino)- $ClC_6H_4CH{:}NC_6H_4OH$	4	127	1
p-Toluenesulfonic acid, 4,6-dinitro-o-tolyl ester $CH_3C_6H_4SO_3C_6H_2(CH_3)(NO_2)_2$	2	209	1

Table 2.--(Continued)

Compound	Concentration per 100 gallons	Borers used	Average mortality
	Pounds	Number	Percent
Ether, 4-tert-butyl-2-chlorophenyl 2,4-dinitrophenyl $C_6H_3(NO_2)_2OC_6H_3ClC(CH_3)_3$	4	105	0.9
Phenol, 4-chloro-2,6-dinitro- $ClC_6H_2(NO_2)_2(OH)$	2	195	.9
Benzoic acid, p-nitro-,alpha-methylproplyidene-hydrazide $NO_2C_6H_4CONHN{:}C(CH_3)C_2H_5$	4	243	.8
Ether, 2,4-dinitrophenyl 1-naphthyl $C_6H_3(NO_2)_2OC_{10}H_7$	4	74	.8
Ether, 2,4-dinitrophenyl p-tolyl $C_6H_3(NO_2)_2OC_6H_4CH_3$	4	78	.8
Phenol, o-(o-chlorobenzylideneamino)- $ClC_6H_4CH{:}NC_6H_4OH$	4	144	.8
Benzylamine, N-(2,4-dinitrophenyl)- $C_6H_5CH_2NHC_6H_3(NO_2)_2$	4	127	.7
Glycine, N-(2,4-dinitrophenyl)- $(NO_2)_2C_6H_3NHCH_2COOH$	4	154	.7
1,5-Naphthalenediol $C_{10}H_6(OH)_2$	4	103	.7
Phenol, o-(anisylideneamino)- $CH_3OC_6H_4CH{:}NC_6H_4OH$	4	135	.7
Phenol, p-(2,4-dinitroanilino)- $(NO_2)_2C_6H_3NHC_6H_4OH$	4	148	.7

Table 2. --(Continued)

Compound	Concentration per 100 gallons	Borers used	Average mortality
	Pounds	Number	Percent
Benzoic acid, *p*-nitrobutylidenehydrazide $NO_2C_6H_4CONHN{:}CHCH_2CH_2CH_3$	4	192	0.6
Ethanol, 2-(2,4-dinitrophenoxy)- $(NO_2)_2C_6H_3OC_2H_4OH$	4	125	.6
Ether, 2,4-dinitrophenyl *m*-nitrophenyl $C_6H_3(NO_2)_2OC_6H_4NO_2$	4	90	.6
Naphthalene, 1,5-bis(2,4-dinitrophenoxy)- $[(NO_2)_2C_6H_3O]_2C_{10}H_6$	4	155	.6
Phenol, *o*-(2,4-dinitroanilino)- $OHC_6H_4NHC_6H_3(NO_2)_2$	4	147	.6
Acetanilide, alpha, alpha, alpha, 4-tetrachloro- $CCl_3CONHC_6H_4Cl$	4	138	.5
Benzoic acid, *p*-nitroisopropylidenehydrazide $NO_2C_6H_4CONHN{:}C(CH_3)_2$	4	193	.5
Dibenzylamine, N-(2,4-dinitrophenyl)- $(NO_2)_2C_6H_3N(CH_2C_6H_5)_2$	4	174	.5
Benzoic acid, *p*-nitro-, hydrazide $NO_2C_6H_4CONHNH_2$	4	244	.4
Benzoic acid, *p*-nitro-piperonylidenehydrazide $NO_2C_6H_4CONHN{:}CHC_6H_3{:}O_2CH_2$	4	189	.4
Sulfide, bis(2,4-dinitrophenyl) $[C_6H_3(NO_2)_2]_2S$	4	248	.4

Table 2. --(Continued)

Compound	Concentration per 100 gallons	Borers used	Average mortality
	Pounds	Number	Percent
Acetanilide, alpha, alpha, 4-trichloro- $CHCl_2CONHC_6H_4Cl$	4	150	0
m-Acetotoluidide, alpha, alpha, alpha-trichloro-alpha^3, alpha^3, alpha^3-trifluoro- $CCl_3CONHC_6H_4CF_3$	4	136	0
Aniline, N-sec-butyl-2,4-dinitro- $(NO_2)_2C_6H_3NHCH(C_2H_5)CH_3$	4	134	0
Benzamide, N-(2-hydroxyethyl)-p-nitro- NO2C6H4CONHCH2CH2OH	4	143	0
Benzoic acid, p-nitrobenzylidenehydrazide NO2C6H4CONHN:CHC6H5	4	213	0
Benzoic acid, p-nitro-propylidenehydrazide $NO_2C_6H_4CONHN:CHCH_2CH_3$	4	180	0
o-Cresol,alpha-(o-hydroxyphenylimino)- $OHC_6H_4CH:NC_6H_4OH$	4	147	0
Cyclohexylamine, N-(2,4-dinitrophenyl)- $C_6H_{11}NHC_6H_3(NO_2)_2$	4	118	0
Ethanol, 2-(2,4-dinitroanilino)- $(NO_2)_2C_6H_3NHCH_2CH_2OH$	4	122	0
Ether, 4-biphenylyl 2,4-dinitrophenyl $C_6H_5C_6H_4OC_6H_3(NO_2)_2$	4	130	0
Ether, 2-bromo-4-tert-butylphenyl 2,4-dinitrophenyl $(NO_2)_2C_6H_3OC_6H_3(Br)C(CH_3)_3$	4	100	0

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Table 2.--(Continued)

Compound	Concentration per 100 gallons	Borers used	Average mortality
	Pounds	Number	Percent
Ether, p-bromophenyl 2,4-dinitrophenyl $C_6H_3(NO_2)_2OC_6H_4Br$	4	92	0
Ether, 2,4-dinitrophenyl p-nitrophenyl $C_6H_3(NO_2)_2OC_6H_4NO_2$	4	52	0